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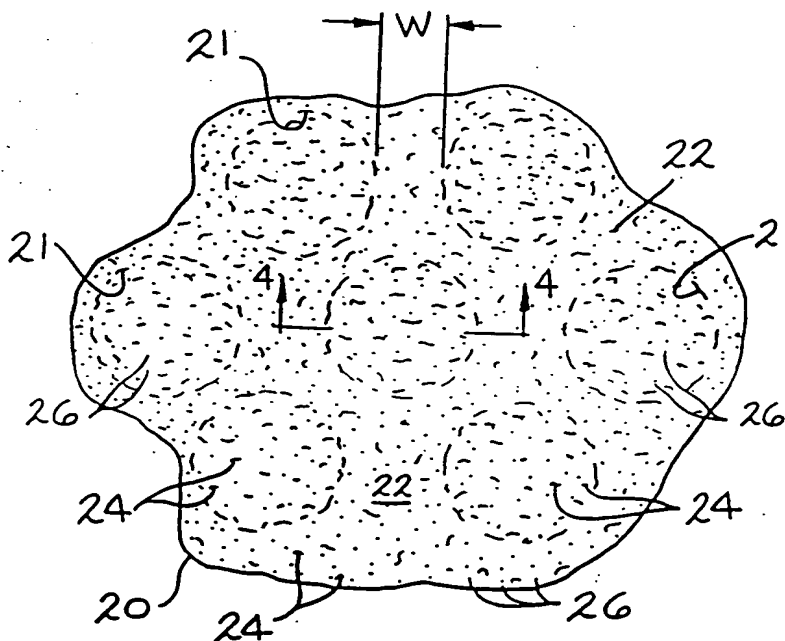
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(54) Title: DEEP EMBOSSED PLASTIC FILM



(57) Abstract

A deep embossed thermoplastic film (20, 30) is disclosed. The film includes a plurality of macro cells (21, 46). The macro cells are interconnected by lands (22) extending between adjacent macro cells. The film also includes at least one plurality of micro depressions (24, 26, 47, 49), whereby a pleasing appearance and a proper feel are imparted.

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DEEP EMBOSSED PLASTIC FILMBACKGROUND OF THE INVENTION

10 The present invention is directed to a deep embossed plastic film and more particularly to a plastic film having a plurality of deep embossed macro cells together with one or more pluralities of micro cells or depressions.

 Embossed plastic films are known in the art and are used as a substitute for textiles. Embossed films may be used for many different
15 purposes such as diaper liners, panty liners and sanitary napkins.

 Examples of prior art films are disclosed in United States Patents Nos. 3,911,187 and 4,518,643.

 When used as a diaper liner or as a substitute for an apparel textile material, many of the prior art films did not have the aesthetic quality that a
20 deep embossed film provides. In addition, many of the prior art films had a final gloss which was not appealing to the eye. Many of the prior art films did not have the tactile characteristics which gave an appealing "feel" quality to the final film product.

 It is, therefore, the object of the present invention to provide an
25 improved deep embossed plastic film which has the characteristics not found in prior art plastic films.

SUMMARY OF THE INVENTION

 The present invention relates to a deep embossed plastic film. The deep embossed plastic film has a plurality of deep embossed macro cells. The macro cells are interconnected by lands extending between adjacent cells.
30 The film also includes at least one plurality of micro cells or depressions. In other embodiments, at least two pluralities of micro cells or depressions are provided on the film.

35

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagrammatic elevational view of a typical apparatus for manufacturing a deep embossed plastic film, according to the present invention;

5 Fig. 2 is a view, similar to Fig. 1, showing another embodiment of apparatus for producing a deep embossed plastic film, according to the present invention;

Fig. 3 is a fragmentary plan view of a deep embossed plastic film, according to the present invention;

10 Fig. 4 is an enlarged cross-sectional view taken along the line 4-4 of Fig. 3;

Fig. 5 is a fragmentary plan view, similar to Fig. 3, of another embodiment of deep embossed plastic film, according to the present invention; and,

15 Fig. 6 is an enlarged sectional view taken along the line 6-6 of Fig. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Fig. 1, an apparatus for producing a deep embossed plastic film, according to the present invention, is generally indicated by the reference number 10. A preformed, flat, longitudinally extending web of thermoplastic film 11 is fed through the nip of driven pull rolls 12 and 13. The thermoplastic film 11 can be formed by either a cast process or a blown process, however, a blown process is normally preferable. The thermoplastic film 11 is generally a polyolefin film, such as polyethylene. However, the present invention is not limited to polyolefin films.

25 The film 11 passes downwardly between spaced apart opposed heaters 14 and 15. The heaters 14 and 15 raise the temperature of the film 11 above its softening point. The heat softened film 11 then passes into a nip 17 formed by a metal embossing roll 18 and a backup roll 19 covered with a outer layer of a resilient material, such as a rubber or rubber like material. In the present embodiment, the embossed macro and micro patterns are imparted as the film 11 passes between the rolls 18 and 19 to generate a deep embossed 30 thermoplastic film 20, according to the present invention.

Other types of polyolefin-type thermoplastic films include polypropylene; copolymers of polyolefins such as ethylene-vinyl acetate copolymers; or modified polyolefins polymers such as polyethylene or polypropylene modified with conventional fillers.

5 The thickness of the unembossed thermoplastic film 10 is normally between .5 mil and 6 mil with a preferable range between .5 mil and 3 mil. The unembossed thickness of the film 10 used to produce the deep embossed plastic film 20, shown in Figs. 3-6, is 1 mil. For many applications, including diaper liners, 1 mil is a preferred thickness of the unembossed film 10.

10 The metal embossing roll 18 may either have a male (protruding) pattern on its outer surface to provide a macro pattern or a female pattern on its outer surface to provide the macro pattern. Referring to Figs. 3 and 4, the deep embossed plastic film has a plurality of deep embossed macro cells 21. The macro cells 21 are interconnected by lands 22 extending between the
15 adjacent macro cells 21. In the Fig. 3 embodiment, a first plurality of random micro depressions 24 are provided in the areas of the macro cells 21 and the lands 22. In the present embodiment, referring to Fig. 1, the macro cells 21 are provided by female patterns on the metal embossing roll 18. The first plurality of micro patterns 24 are provided by placing a coarse sandblast
20 pattern on the surface of the metal embossing roll 18. In another embodiment, as will be discussed below in connection with the Fig. 2 apparatus, a first set of embossing rollers can be used to produce a micro pattern followed up by a second set of embossing rollers to produce the macro pattern.

As shown in Fig. 4, the depth "D" is preferably between 2.5 mil and
25 15 mil. The depth "D" of the film 20, shown in Figs. 3 and 4, is 4 mil.

In the deep embossed plastic film 20, shown in Figs. 3 and 4, the first plurality of micro depressions 24 are imparted by placing a coarse sandblast pattern on the metal embossing roll 18. It has been found that this coarse sandblast pattern, which results in the random pattern of micro depressions
30 24, provides an improved tactile quality to the film 20 resulting in a desired "feel" of the final film 20. Preferably, the rough sandblast pattern on the roll 18 falls within a range of 50 to 250 micro inches RA, measured on a perthometer. A preferred range is between 75 and 150 micro inches RA. As

1,25 - 6,75 μ m

discussed above, this sandblast pattern can be placed on the metal embossing roll 18 or on another pair of rolls, such as those shown in Fig. 2.

In the present embodiment, there is a second plurality of micro depressions 26 in the film 20. The second plurality of micro depressions 26 in the present embodiment are randomly placed and are formed by a fine sandblast pattern placed on the metal embossing roll 18. It has been found that the second plurality of micro depressions 26 eliminate the gloss and aid in forming a deep embossed film having an aesthetically pleasing appearance. Preferably, the second plurality of micro depressions 26 are formed by placing a fine sandblasting pattern on the roll 18 having a perthometer measurement of less than 85 micro inches RA and preferably less than 50 micro inches RA. The resilient roll 19, in the present embodiment, is preferably ground to a perthometer range of 35 to 75 micro inches RA.

The film 20 preferably has between 8 and 120 macro cells 21 per inch. More particularly, the embodiment shown in Fig. 3 has 22 macro cells 21 per inch.

As discussed above, the film 20 is constructed by a one-stage process where all three patterns are placed on the metal embossing roll 18. When the film 11 passes between the rolls 18 and 19, the three patterns form the macro cells 21, the first plurality of micro depressions 24 and the second plurality of micro depressions 26.

While the widths vary, in the present embodiment the width "W" of the lands 22 is .020 inch. It is understood that the width W varies inversely with respect to the depth "D". Normally, if the metal embossing roll 18 is a male roll, the depths would be deeper, approaching the 15 mil depth. In those situations, the width "W" of the lands 22 is reduced.

Referring to Fig. 2, another embodiment of apparatus used to manufacture a deep embossed thermoplastic film 30, according to the present invention, is generally indicated by the reference number 31. A preformed thermoplastic film 32, similar to the film 11 discussed above, is fed through the nip of a pair of pull rolls 33 and 34. The thermoplastic film 32 is then softened by heaters 35 and 36 positioned on opposite sides of the film 32. The heat softened film 32 is then fed through the nip 37 formed by a metal

embossing roll 38 and a backup roll 39. The backup roll 39 again has a resilient rubber or rubber-like surface, as discussed above. Next, the film is fed through a nip 42 defined by a second metal embossing roll 43 and a second resilient backup roll 44. The completed deep embossed thermoplastic film 30, according to the present invention, is removed to a windup roll (not shown).

Referring to Figs. 5 and 6, the deep embossed thermoplastic film 30, according to the present invention, includes a plurality of macro cells 46. Again, there are preferably 8 to 120 macro cells 46 per inch in the film 30. The metal embossing roll 43 may either have a male (protrusion) pattern or a female pattern. The macro cells 46 are formed as the softened thermoplastic film 32 passes between the second pair of rolls 43 and 44. The deep embossed thermoplastic film 30 also includes a first plurality of micro depressions or cells 47. In the present embodiment, the first plurality of micro cells 47 are generally diamond shaped and have a structured pattern, as opposed to the random pattern of the Fig. 3 embodiment. The first plurality of micro cells 47 are formed as the softened film 32 passes between the first pair of rolls 38 and 39. In this embodiment, the diamond shaped pattern is placed on the metal embossing roll 38 to form the diamond shaped micro cells 47. There are approximately 120 to 150 micro cells 47 per inch in the deep embossed thermoplastic film 30.

The macro cells 46 or 21 may have many shapes. me geometry includes triangles, quadrilaterals or increasing multi-sided figures up to and including circles. Similarly, the structured pattern 47 can be patterns other than a diamond pattern and fall within the scope of the present invention.

The diamond shaped micro cells 47 of the deep embossed thermoplastic film 30 provides the tactile quality which, again, results in a proper "feel". The present embodiment also includes a second plurality of random micro cells or depressions 49. The second plurality of random depressions 49 are formed by placing a fine sandblasting pattern on the metal embossing roll 43. As was true in the first embodiment, the sandblast pattern placed on the roll 43 has a preferred perthometer reading of less than 50 micro inches RA. While the structured diamond pattern which forms the micro cells 47 is placed

on the upper metal embossing roll 38 and the fine sandblast pattern forming the micro cells 49, together with the macro pattern forming the macro cells 46 both placed on the lower metal embossing roll 43, it should be understood that various ones of the patterns can be moved to the other metal embossing roll 38 or 43 or all three patterns placed on one roll 38 or 43, without departing from the scope of the present invention.

The unembossed film 32 preferably has a thickness between .5 mil and 6 mil. The preferred thickness of the film 32 is 1 mil.

The films 20 and 30, according to the present invention, are suitable for use in the disposables field, in agricultural applications and in packaging applications. The films 20 and 30 and other embodiments according to the present invention can specifically be used in diaper back sheets, panty liners, and sanitary napkins.

Many revisions and changes may be made to the specific embodiments disclosed above without departing from the scope of the present invention or from the following claims.

Claims:

- 5 1. A deep embossed thermoplastic film (20,30), said film having a plurality of deep embossed macro cells (21,46) interconnected by lands (22) extending between adjacent macro cells and at least one plurality of micro depressions (24,26,47,49).
- 10 2. A deep embossed thermoplastic film (20,30), according to claim 1, wherein said thermoplastic film is a polyolefin film.
3. A deep embossed thermoplastic film (20,30), according to claim 1, wherein said micro depressions (24,26,47,49) are provided on said lands (22).
- 15 4. A deep embossed thermoplastic film (20,30), according to claim 1, wherein said micro depressions (24,26,47,49) are provided on said lands (22) and in said macro depressions (21,46).
- 20 5. A deep embossed thermoplastic film (20,30), according to claim 1, wherein said thermoplastic film includes two pluralities of micro depressions (24,26 and 47,49).
- 25 6. A deep embossed thermoplastic film (30), according to claim 1, wherein said thermoplastic film includes one plurality of micro depressions (47) comprising a structured pattern.
7. A deep embossed thermoplastic film (30), according to claim 6, wherein said structured pattern is a diamond pattern (47).
- 30 8. A deep embossed thermoplastic film (20,30), according to claim 6, having a second plurality of micro depressions (26, 49) comprising a random sandblast pattern.

9. A deep embossed thermoplastic film (20,30), according to claim 5, wherein a first plurality of micro depressions (24) comprise a coarse sandblast pattern and a second plurality of micro depressions (26) comprise a fine sandblast pattern.

5

10. A deep embossed polyolefin film (20,30), said film having a plurality of deep embossed macro cells (21,46), said macro cells interconnected by lands (22) extending between adjacent macro cells, a first plurality of random micro depressions (24) comprising a coarse sandblast pattern and a second plurality of random micro depressions (26,49) comprising a fine sandblast pattern.

10

11. A deep embossed polyolefin film (20,30), according to claim 10, wherein said macro cells (21,46) have a depth of between 2.5 mils and 15 mils.

15

63.5 mils 23 mils

12. A deep embossed polyolefin film (20,30), according to claim 11, wherein said film includes between 8 and 120 macro cells/inch.

20

13. A deep embossed film (20,30), according to claim 1 or 10, wherein said film is used in a diaper back sheet, a panty liner or a sanitary napkin.

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AMENDED CLAIMS

[received by the International Bureau on 2 November 1992 (02.11.92);
original claims 1 and 11 deleted;
original claims 2-6,8,10,12 and 13 amended;
new claims 14 and 15 added; remaining claims unchanged (3 pages)]

5

1. Cancel.

2. A deep embossed thermoplastic film (20,30), according to claim 14, wherein said thermoplastic film is a polyolefin film.

10

3. A deep embossed thermoplastic film (20,30), according to claim 14, wherein said micro depressions (24,26,47,49) are provided on said lands (22).

15

4. A deep embossed thermoplastic film (20,30), according to claim 14, wherein said micro depressions (24,26,47,49) are provided on said lands (22) and in said macro depressions (21,46).

20

5. A deep embossed thermoplastic film (20,30), according to claim 14, wherein said thermoplastic film includes two pluralities of micro depressions (24,26 and 47,49).

25

6. A deep embossed thermoplastic film (30), according to claim 14, wherein said thermoplastic film includes one plurality of micro depressions (47) comprising a structured pattern.

7. A deep embossed thermoplastic film (30), according to claim 6, wherein said structured pattern is a diamond pattern (47).

8. A deep embossed thermoplastic film (20,30), according to claim 14, having a second plurality of micro depressions (26, 49) comprising a random sandblast pattern.

9. A deep embossed thermoplastic film (20,30), according to claim 5, wherein a first plurality of micro depressions (24) comprise a coarse sandblast pattern and a second plurality of micro depressions (26) comprise a fine sandblast pattern.

10. A deep embossed polyolefin film (20,30), said film having a plurality of deep embossed macro cells (21,46), said macro cells interconnected by lands (22) extending between adjacent macro cells, said macro cells having a depth of between 2.5 mils and 15 mils, a first plurality of random micro depressions (24) comprising a coarse sandblast pattern, said first plurality of micro depressions having a perthometer range of 50 to 250 micro inches RA, and a second plurality of random micro depressions (26,49) comprising a fine sandblast pattern, said second plurality of random micro depressions having a perthometer measurement of less than 85 micro inches RA.

11. Cancel.

12. A deep embossed polyolefin film (20,30), according to claim 10, wherein said film includes between 8 and 120 macro cells/inch.

13. A deep embossed film (20,30), according to claim 10 or 14, wherein said film is used in a diaper back sheet, a panty liner or a sanitary napkin.

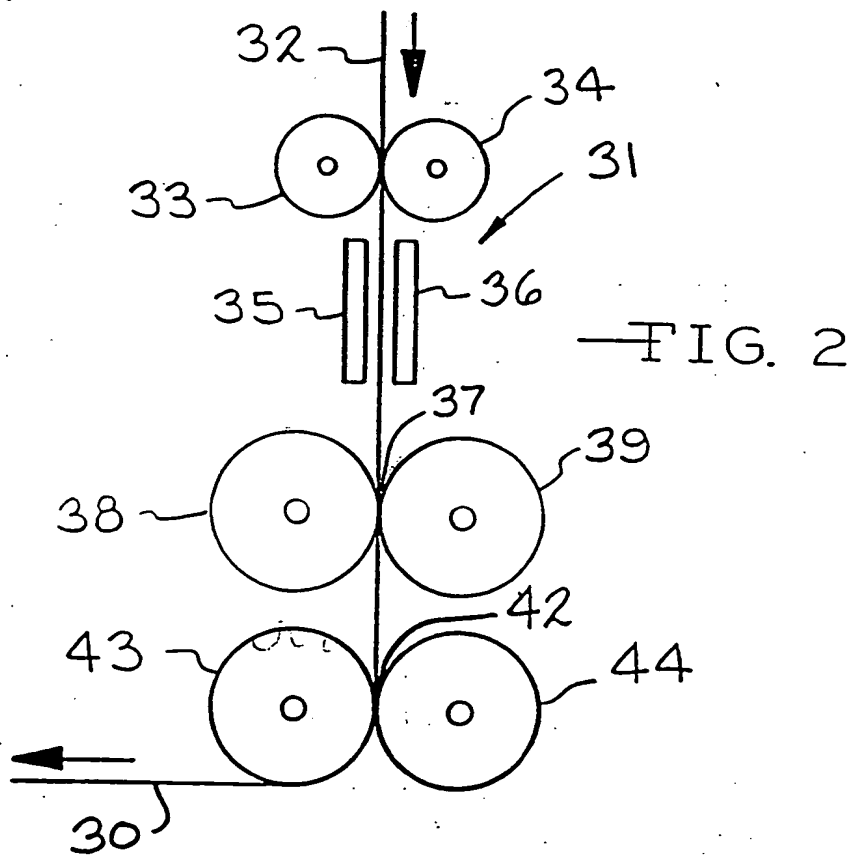
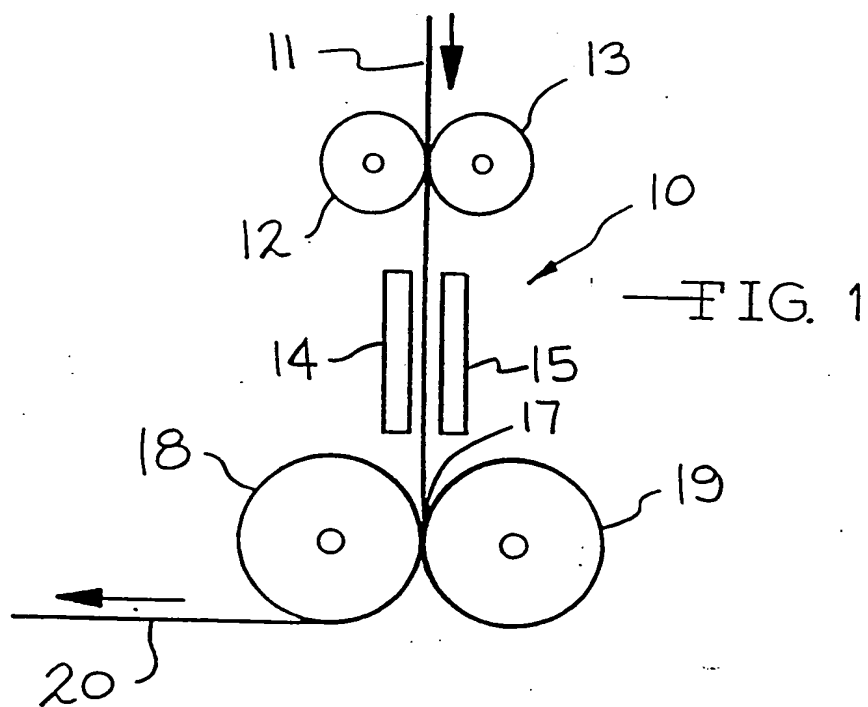
14. A deep embossed thermoplastic film (20, 30), having a plurality of deep embossed macro cells (21, 46) interconnected by lands (22) extending between adjacent macro cells, said macro cells having a depth of between 2.5 mils and 15 mils and at least one plurality of micro depressions (24, 26, 49) provided in addition to said macro cells, said micro depressions having a perthometer range of 35 to 250 micro inches RA.
15. A deep embossed thermoplastic film (20, 30), having a plurality of deep embossed macro cells (21, 46) interconnected by lands (22) extending between adjacent macro cells, said macro cells including a repeating macro cell pattern having a central macro cell surrounded by six spaced macro cells, said macro cells having a depth of between 2.5 mils and 15 mils and at least one plurality of micro depressions (24, 26, 49) provided in addition to said macro cells, said micro depressions having a perthometer range of 35 to 250 micro inches RA. → 6.15 μm

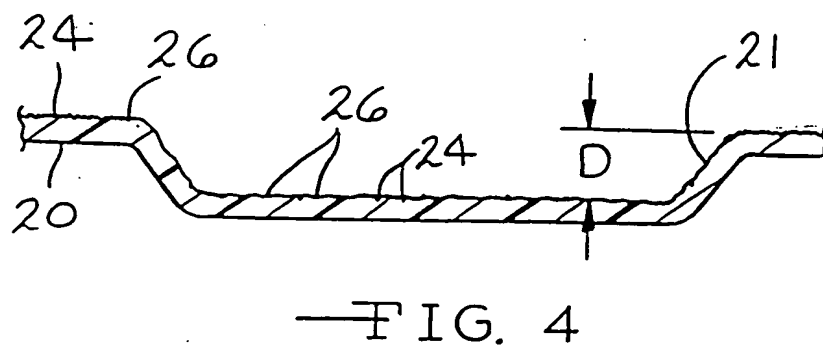
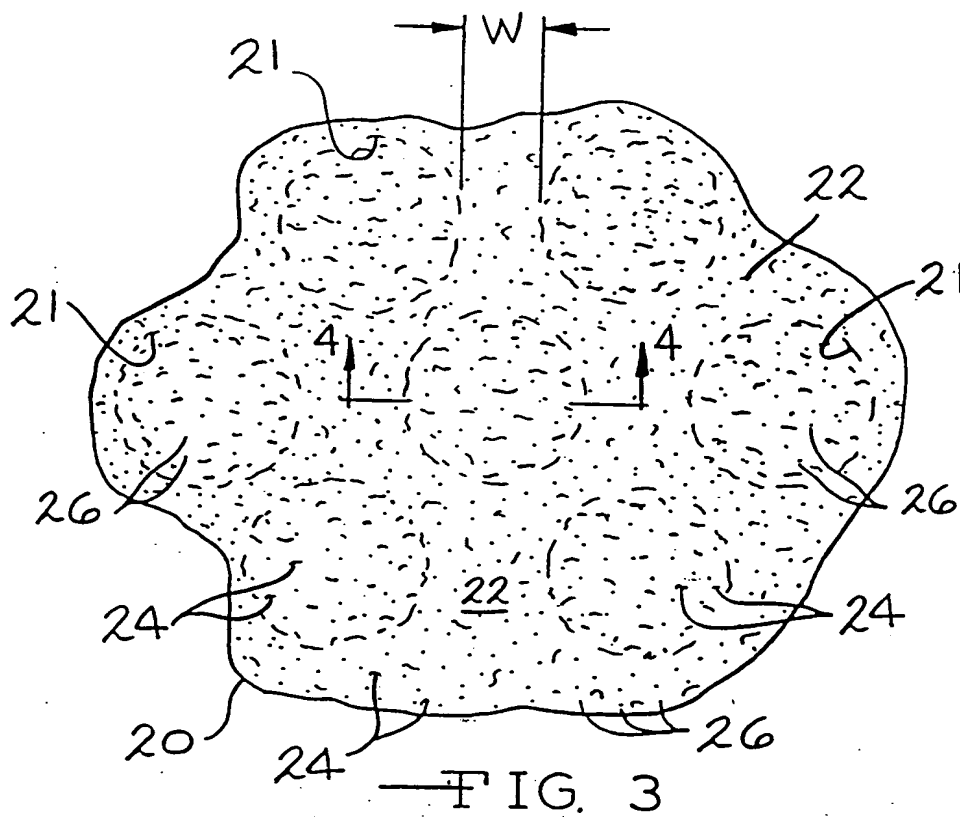
STATEMENT UNDER ARTICLE 19

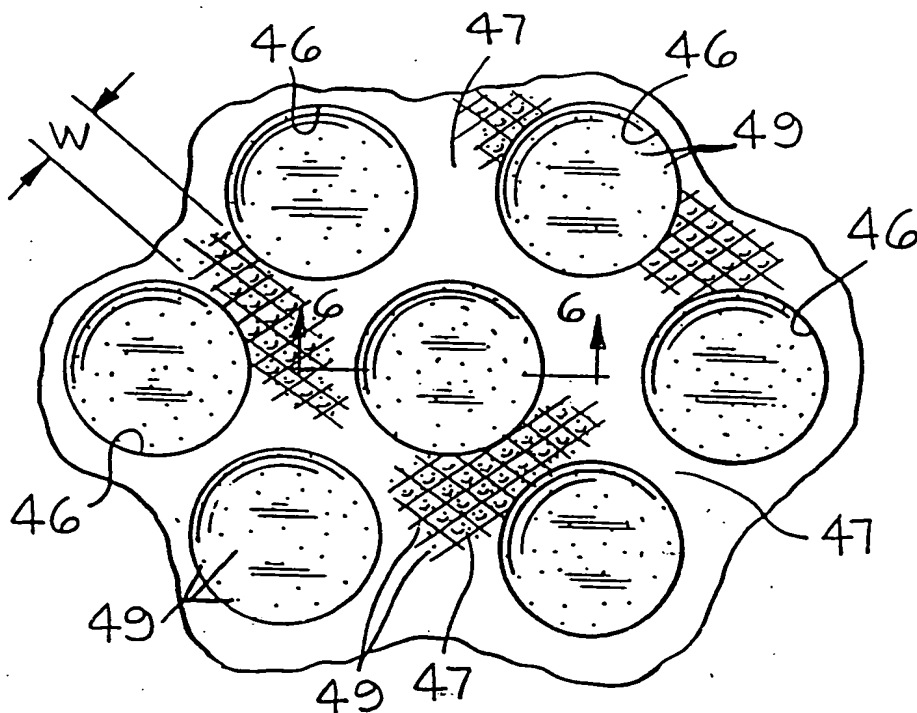
Applicant has canceled claims 1 and 11. Applicant has also amended independent claim 10 and has added two substitute independent claims 14 and 15. Further, Applicant has amended claims 2-6 and claim 8 to depend from claim 14. Claim 12 has been amended to depend from claim 10. Claim 13 has been amended to depend from claim 10 or 14.

The claims, as amended, more specifically define the structure of Applicant's claimed invention relating to a deep embossed film. Each of the independent claims 10, 14 and 15 specifically recite that the film (20, 30) include macro cells (21, 46) interconnected by lands (22) and that the macro cells have a depth of between 2.5 mils and 15 mils. The independent claims also recite that the film (20, 30) includes at least one plurality of micro depressions (24, 26 and 47, 49) and that the micro depressions have a perthometer range of 35 to 250 micro inches RA.

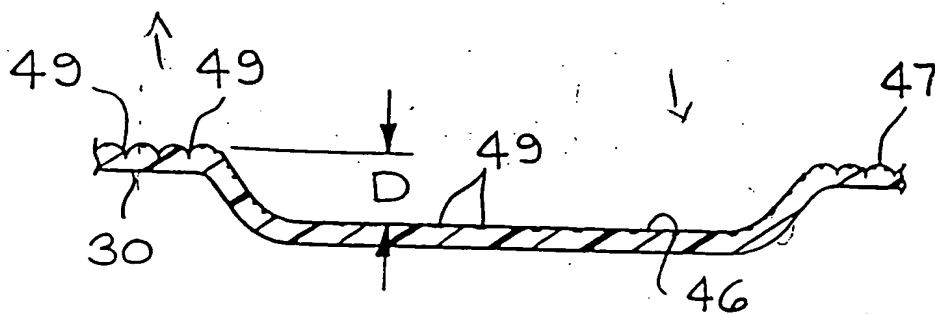
Newly added independent claim 15 also recites that the macro cells (21, 46) include a repeating cell pattern having a central macro cell surrounded by six spaced macro cells as shown in Figs. 3 and 5 of the drawings.







—FIG. 5



—FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US92/05495

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B32B 3/00

US CL :428/141,156,178,212,409,500

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 51/4120; 156/209,244.25; 264/162,284

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
<input checked="" type="checkbox"/> X <input checked="" type="checkbox"/> Y	US, E, RE 23,910 (SMITH) 14 December 1954, See the entire document.	<u>1-6,8-10</u> 7,11-13
<input checked="" type="checkbox"/> X <input checked="" type="checkbox"/> Y	US, A, 3,484,835 (TROUNSTINE) 16 December 1969, See the entire document.	<u>1-6,8-10</u> 7,11-13
<input checked="" type="checkbox"/> X <input checked="" type="checkbox"/> Y	US, A 3,849,050 (ADAMS) 19 November 1974, See the entire document.	<u>1-6,8-10</u> 7,11-13
<input checked="" type="checkbox"/> X <input checked="" type="checkbox"/> Y	US, A, 3,950,480 (ADAMS) 13 April 1976, See the entire document.	<u>1-6,8-10</u> 7,11-13
<input checked="" type="checkbox"/> X <input checked="" type="checkbox"/> Y	US, A, 4,376,147 (BYRNE) 08 March 1983, See the entire document.	<u>1-6,8-10</u> 7,11-13
<input checked="" type="checkbox"/> X <input checked="" type="checkbox"/> Y	US, A, 4,436,520 (LIPKO) 13 March 1984, See the entire document.	<u>1-6,8-10</u> 7,11-13
<input checked="" type="checkbox"/> X <input checked="" type="checkbox"/> Y	US, A, 4,518,643 (FRANCIS) 21 May 1985, See the entire document.	<u>1-6,8-10</u> 7,11-13

☐ Further documents are listed in the continuation of Box C.

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Date of the actual completion of the international search

12 AUGUST 1992

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/05495

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
$\frac{X}{Y}$	US, A, 4,546,029 (CANCIO) 08 October 1985, See the entire document.	$\frac{1-6,8-10}{7,11-13}$